Soil Moisture Active Passive (SMAP) Applications Workshop

Human Health

NOAA Science Center Auditorium,
1301 East West Highway, Silver Spring, MD 20910
9-10 September 2009

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Public Health

Public health fulfills society’s interest in assuring conditions in which people can be healthy.

-- IOM (1988)

Public health is one of the efforts to protect, promote and restore the people’s health. It combines sciences, skills and beliefs to maintain and improve the health of all the people through collective or social actions”.

--J. Last *Dictionary of epidemiology* (2001)

Weather Forecasting

Galveston, TX

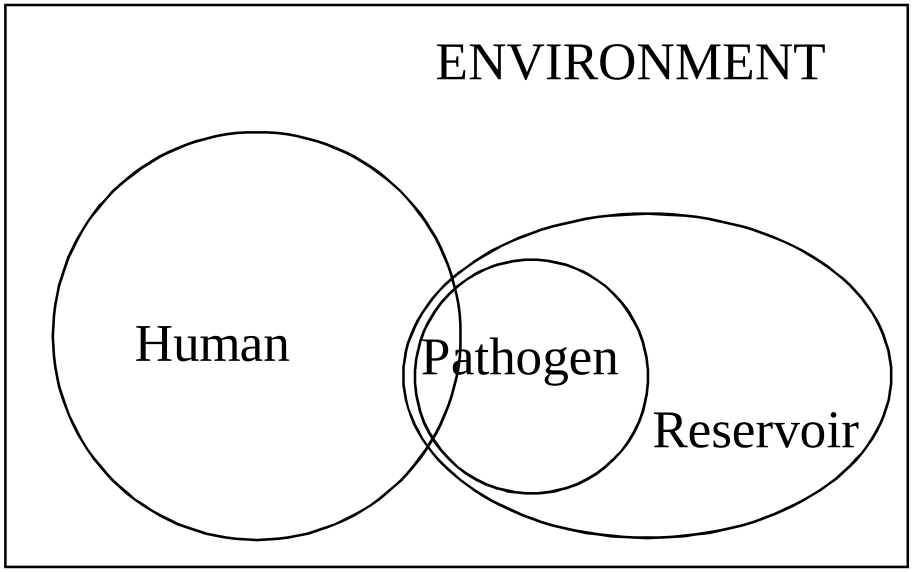
Drought & Flooding

NOAA 2005

Loss of Agricultural Resources

Infectious Disease

- ***Vector-borne/Zoonotic diseases:*** Pathogen primarily resides in a second species and is transmitted to humans for example, rabies, malaria, Lyme disease



- Up to 75% of newly recognized diseases

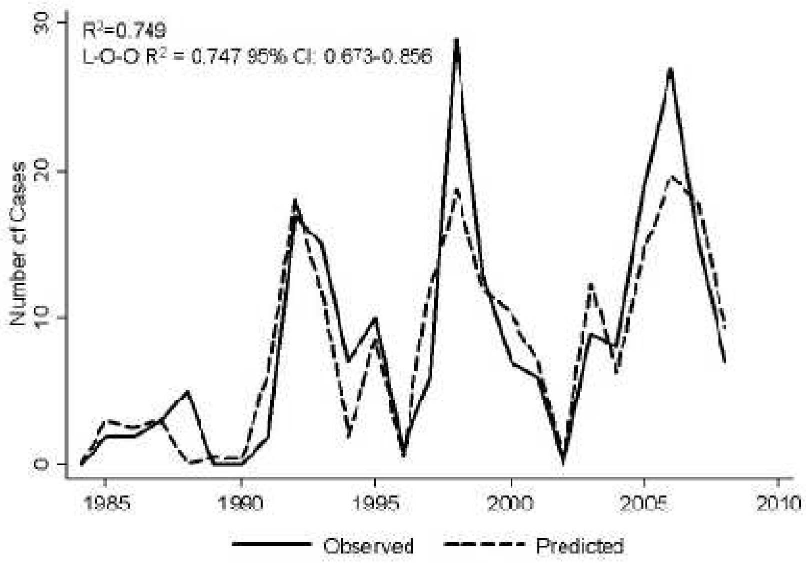
- Can affect 100's millions annually; millions of deaths

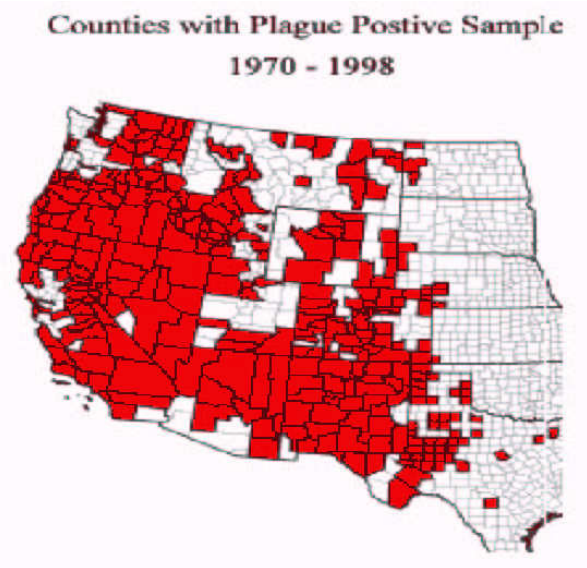
Goal of Disease Forecasting

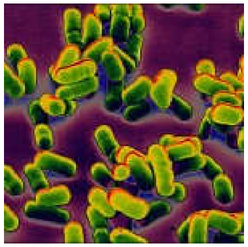
- Identify leading environmental indicators of changing levels of disease risk (over time and/or space)
- Characterize effect of time/space scale
- Monitor/evaluate for targeted intervention(s) as needed

- **Long-term**: Reduce costs of implementation while maintaining or improving health

Bubonic Plague: U.S. CDC





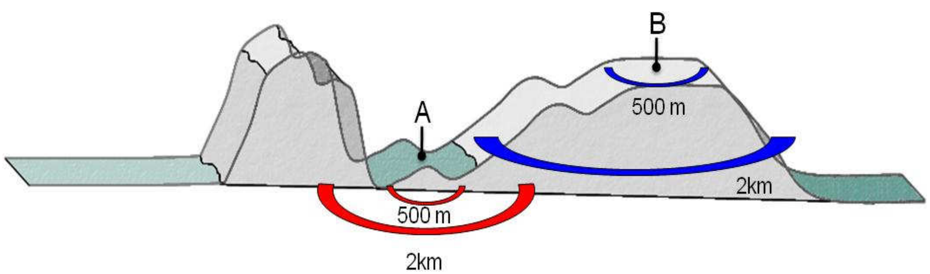


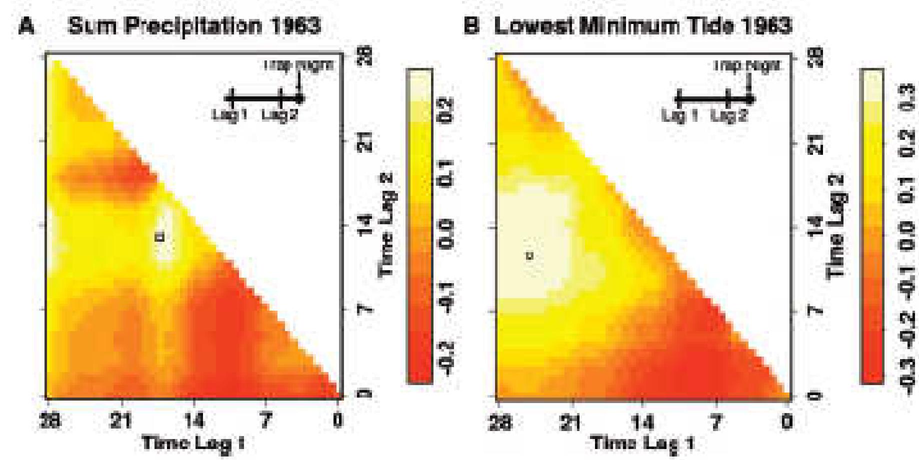
	coef	p var	p model	R^2	AIC	df	Link	OV Test	Het Test
			<0.0001	0.749	63.33	5	0.49	0.32	0.14
Surveillance1991	1.89	0.000							
1 yr lag Precip	0.36	0.000							
3 yr lag > 27°C	0.09	0.006							
4 yr lag Winter Tmax	0.27	0.009							

Brown et al, in press

Dynamics of Vector Populations Respond to Short-term Patterns of Environment

- "We'll get lots of mosquitoes if we got rain a few weeks ago."
- "A few weeks" isn't clear enough. Or is it? Could that be 'real'?





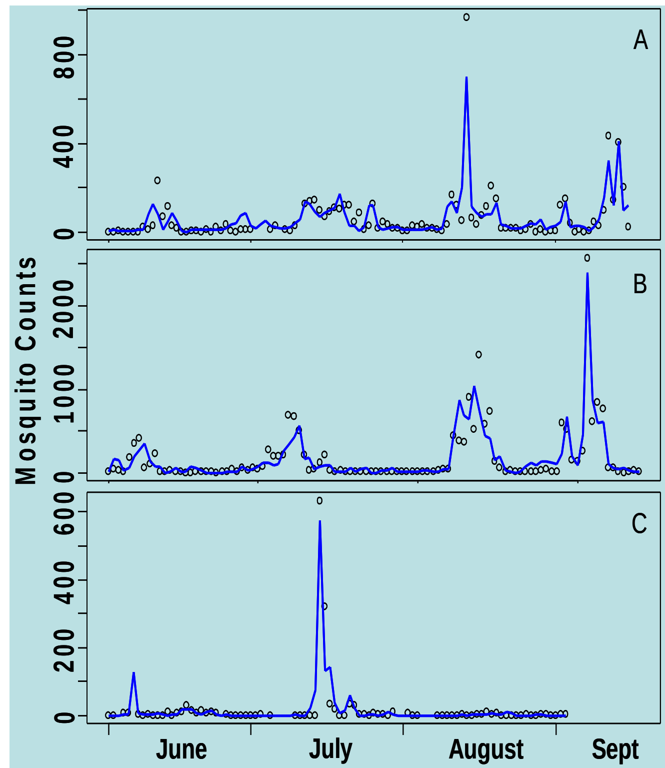
Shone et al 2006

Leading Environmental Factors Predict Mosquito Abundance

$y(t) \sim \text{Pois}(\lambda(t))$

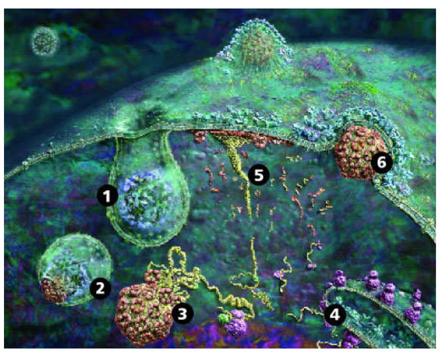
$\log(\lambda(t)) = \beta_0 + \beta_1\text{PRCP} + \beta_2\text{TMIN} + \beta_3\text{CLDD} + \beta_4\text{MNTD} + \beta_5\text{MNRH} + \beta_6\text{PRCP} + \beta_7\text{FLOW}$

Meteorological Variable	Aggregate	days (Lag 1, Lag 2)
PRCP: Precipitation	**Total**	**(22, 9)**
TMIN: Minimum Temperature	**Lowest**	**(28, 13)**
MNTD: Minimum Tide	**Lowest**	**(27, 14)**
MNRH: Minimum Humidity	**Average**	**(28, 9)**
FLOW: Stream Flow	**Minimum**	**(11,0)**
PRCP: Precipitation	**Total**	**(1, 0)**
CLDD: Cooling Degree Days	**Total**	**(0, 0)**



Shone et al 2006

Dengue Forecasts: U.S. CDC



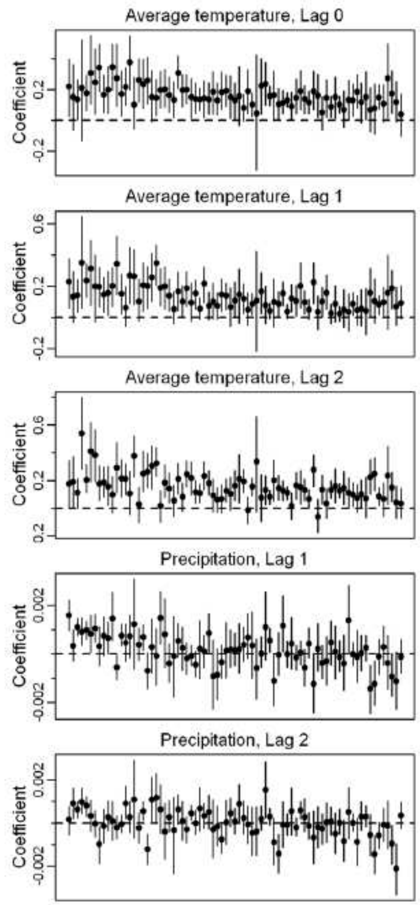


Figure 1. Local short-term associations between weather and dengue incidence. Points represent the estimated proportional increase in dengue incidence for an increase in monthly temperature (1°C) or precipitation (1 mm) in each municipality at each lag (months). All lagged weather variables were included in the regression model simultaneously. Municipalities are ordered by mean average temperature or precipitation, low to high (left to right). Black bars indicate the 95% credible interval for each estimate based on 1,000 models, one for each conditional simulation of weather data.
doi:10.1371/journal.pntd.0000382.g001

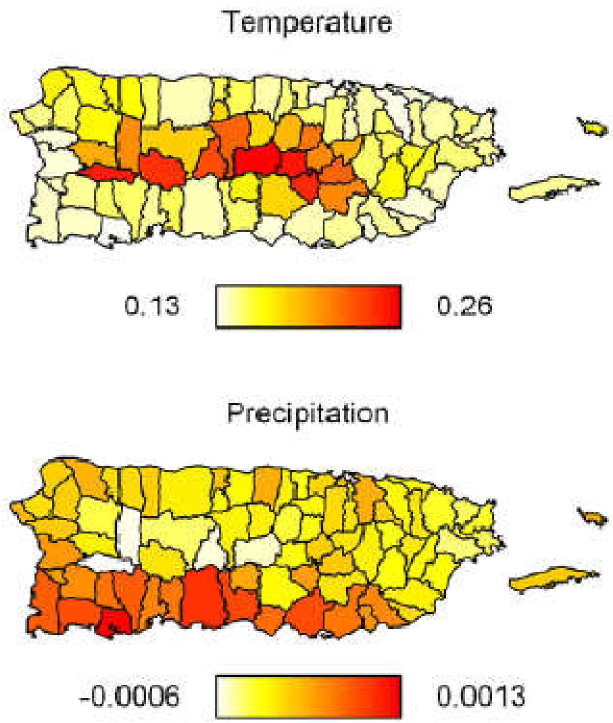
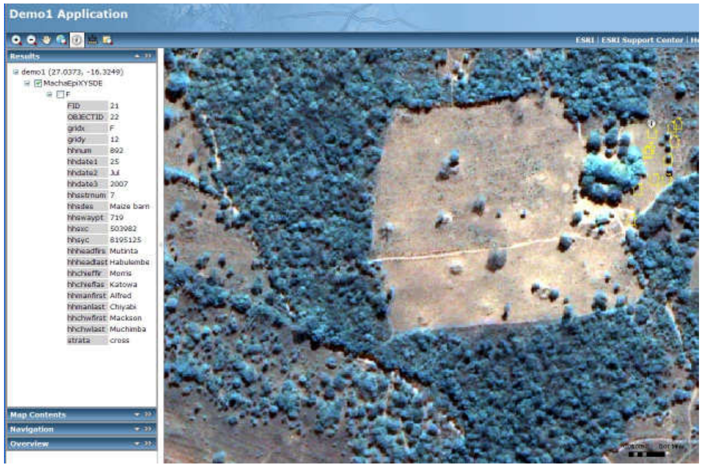


Figure 3. Spatial effects of climate on dengue incidence. Colors represent the relative strength of the cumulative association between monthly temperature and precipitation in each municipality. This is calculated as the cumulative effect of a 1°C increase in mean monthly temperature on dengue incidence in the current and two subsequent months and of a 1 mm increase in precipitation on dengue incidence in the two following months.
doi:10.1371/journal.pntd.0000382.g003

Johansson et al 2009

National Malaria Control Program - Zambia; Surveillance; Population



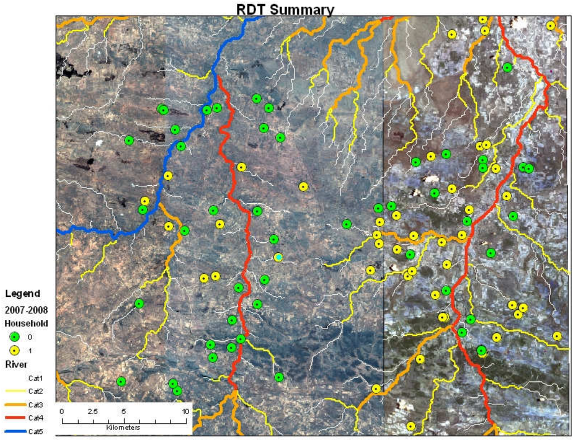
Investigator data sets

Census

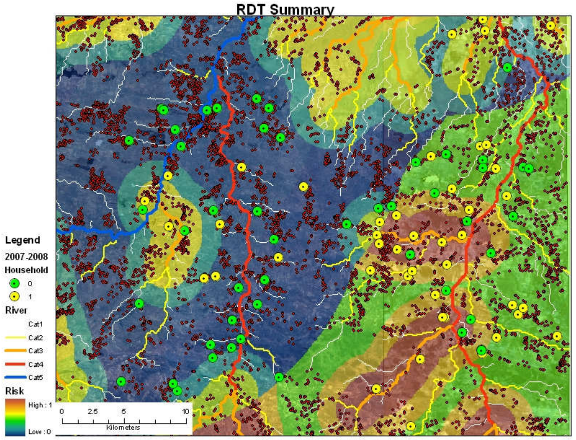
Field study selection

Training

Research Questions

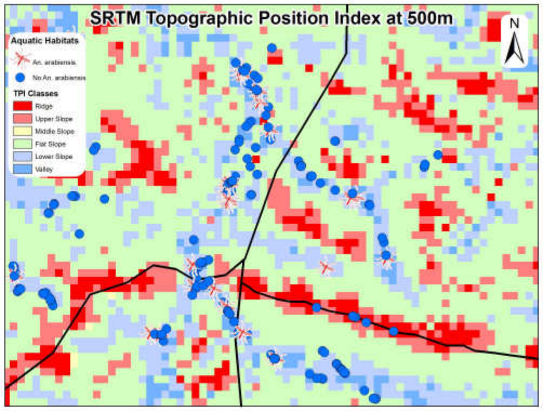


Census data for sampling frame



Identify correlates of infection

An arabiensis larval site identification

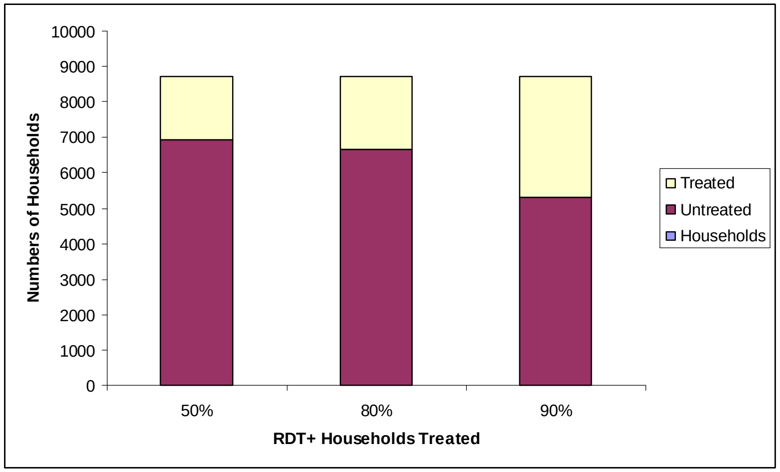


Identify predictors of breeding sites

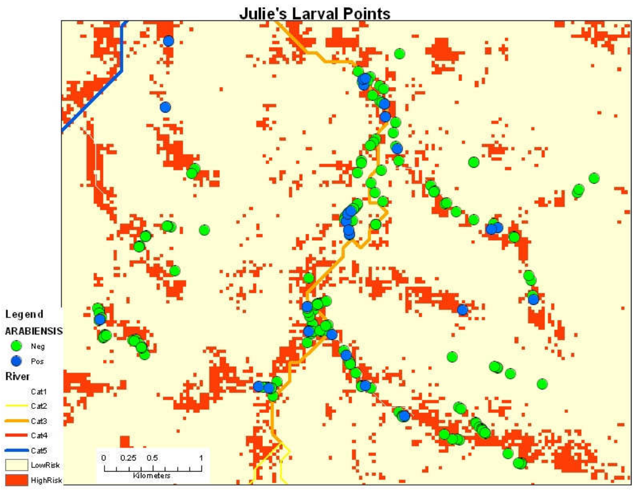
Programmatic Target Intervention

Tested Households	N	Tests	Negative	Positive
Below Threshold				
RDT Negative	30	252	252	0
RDT Positive	5	86	81	5
Percent Positve Tests				1.5
Above Threshold				
RDT Negative	19	133	133	0
RDT Positive	40	446	332	114
Percent Positve Tests				19.7

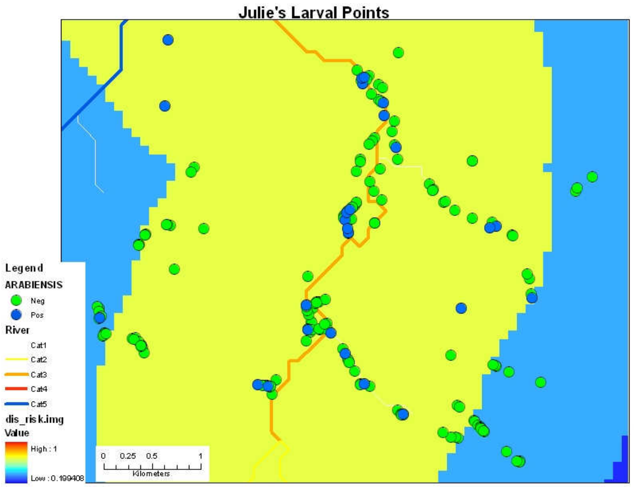
Enrichment of Households with Infection; Heterogeneity in Intensity



Provides approach for targeted intervention



Exclude large portions of region as potential breeding sites



Breeding sites only near human risk areas

Summary

- Many of SMAP applications are directly related to public health issues (floods, food security, etc)
- In addition, the risk from many infectious agents vary in time and space and are influenced by factors related to SMAP level 3 & 4 data products
- These agents affect populations at national and international levels